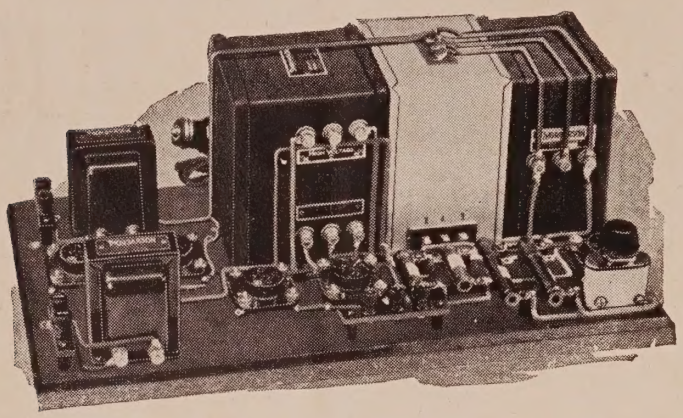
How to build the THORDARSON HEAVY DUTY POWER AMPLIFIER and B-SUPPLY

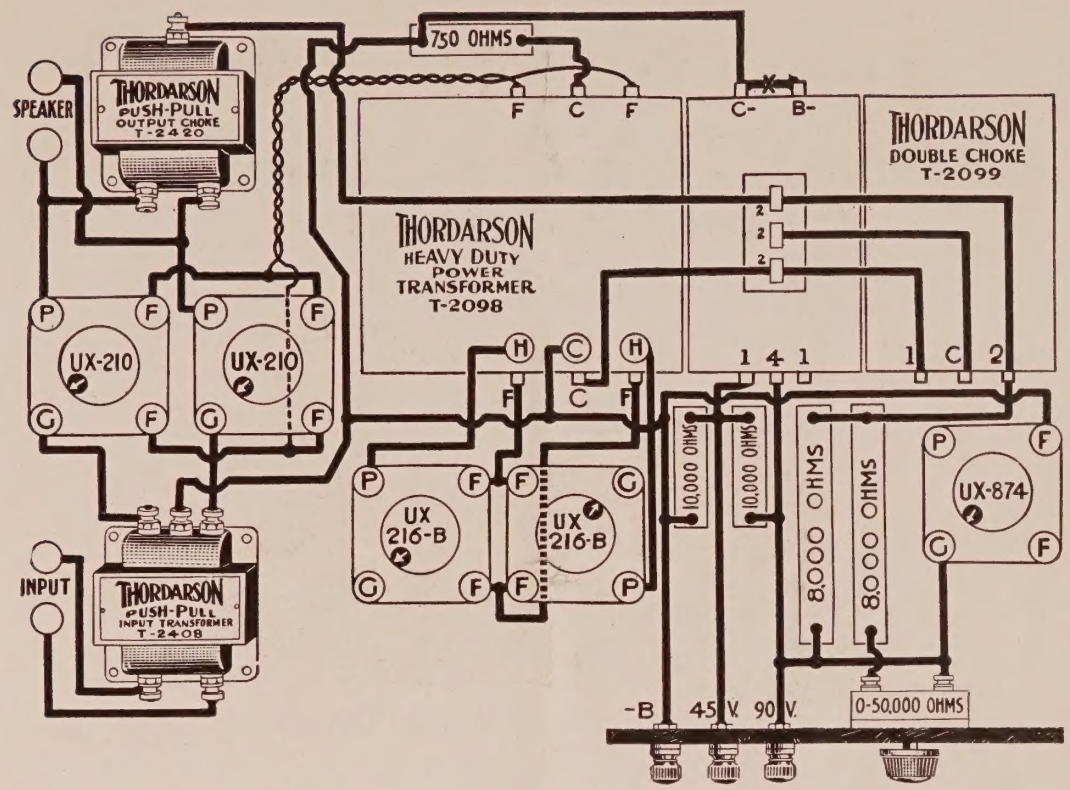
The THORDARSON
210 Push-Pull Power Amplifier and B-Supply



For the man who seeks the ultimate in radio reproduction there can be no substitute for power amplification. Just as reserve power is so essential for smooth operation of an automobile, a certain amount of reserve power is necessary in the audio output of a receiver if full reproduction is desired.

The Thordarson Heavy Duty Power Amplifier operates two UX-210 power tubes in push-pull at full capacity, giving a total undistorted power output of well over 3,000 milliwatts, or more than 200 times the power output of the standard 201-A type of amplifying tube. Such an amplifier is capable of delivering undistorted power to the loud-speaker with a sufficient reserve to meet all normal requirements.

Quite naturally, this amplifier can handle great volume. Volume, however, is not the main objective any more than an 80 mile per hour automobile is expected to travel at top speed through traffic. Just as the excess power of the automobile gives easier control at average speeds, the reserve power in this amplifier provides a greater fullness and richness of tone to the receiver when operated at normal volume. The effectiveness of power amplification is perhaps most noticeable in the



Pictorial Diagram Showing Simple Baseboard Assembly and All Wiring

full reproduction of the heavier tones, which heretofore, due to the inadequate capacity of the standard amplifying tube, have been sadly neglected in the receivers of yesterday.

The construction of this heavy duty power amplifier is amazingly simple. The wooden baseboard assembly illustrated herein involves the use of but three tools available to all home constructors, namely a screw-driver, a pair of pliers, and a soldering iron. With the aid of the simple pictorial diagram, it is possible, even for the man who has never before assembled any radio apparatus, to build this amplifier in an evening's time.

All the parts used in the complete amplifier are standard parts of recognized quality which are available at all good radio parts dealers. They are listed below:

1 Thordarson Power Supply Transformer, T-2098

1 Thordarson Double Choke Unit, T-2099

1 Thordarson Push-Pull Input Transformer, T-2408

1 Thordarson Push-Pull Output Choke, T-2420
(If used with Magnavox Speaker, R-4 or R-5, substitute Thordarson Output Transformer, T-2629)

1 Condenser Block
Dubilier PL-575, Tobe R-210, or equivalent

2 Fixed Resistances, 8,000 ohms
Ward-Leonard, 508-3

2 Fixed Resistances, 10,000 ohms
Ward-Leonard, 508-4

1 Fixed Resistance, 750 ohms
Ward-Leonard, 507-54

1 Variable Resistance, 0-75,000 ohms
Bradleyohm, R-5 or equivalent

5 Spring Sockets
7 Binding Posts

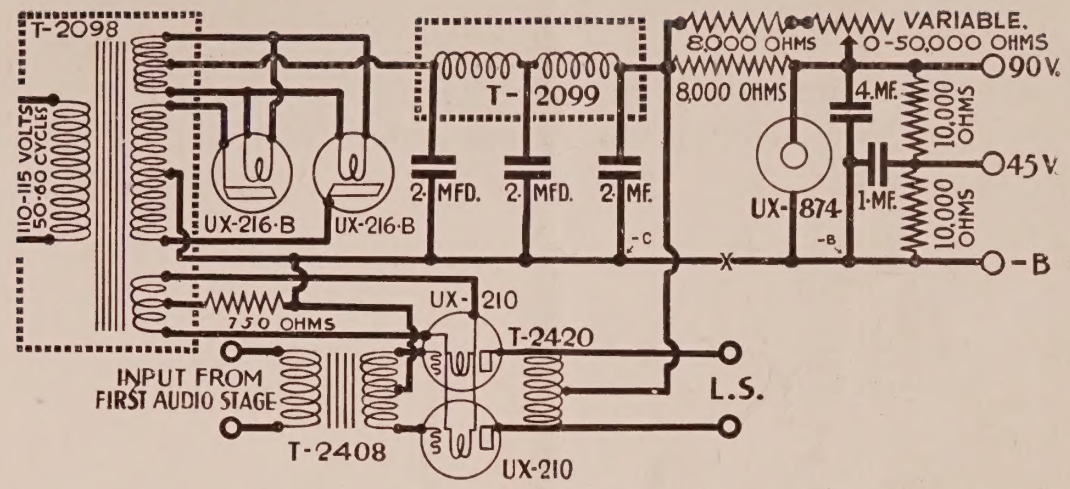
The following tubes are required for use in this amplifier:

2 UX-210, or CX-310 Power Amplifying Tubes

1 UX-874 or CX-374 Voltage Regulator Tube

2 UX-281 or CX-381 Rectifying Tubes
(Type UX-216-B or CX-316-B may be directly substituted for the 281 type. One Raytheon type H, or Q.R.S. 100 mill. full wave rectifier also may be used as per diagram on page 5)

The Thordarson heavy duty power supply transformer, T-2098 is designed for 60 cycle, 115 volt service. Secondary No. 1, of 550 volts each side of center tap is used as the rectifier supply. The terminals of this secondary are marked H-C-H. Secondary No. 2 is directly under secondary No. 1 and is marked F-C-F. This is a 7½ volt winding, center tapped and serves as the filament supply for the rectifying tubes. Secondary No. 3 is on the opposite end of the transformer and is also rated at 7½ volts. This is the filament supply for the UX-210 power



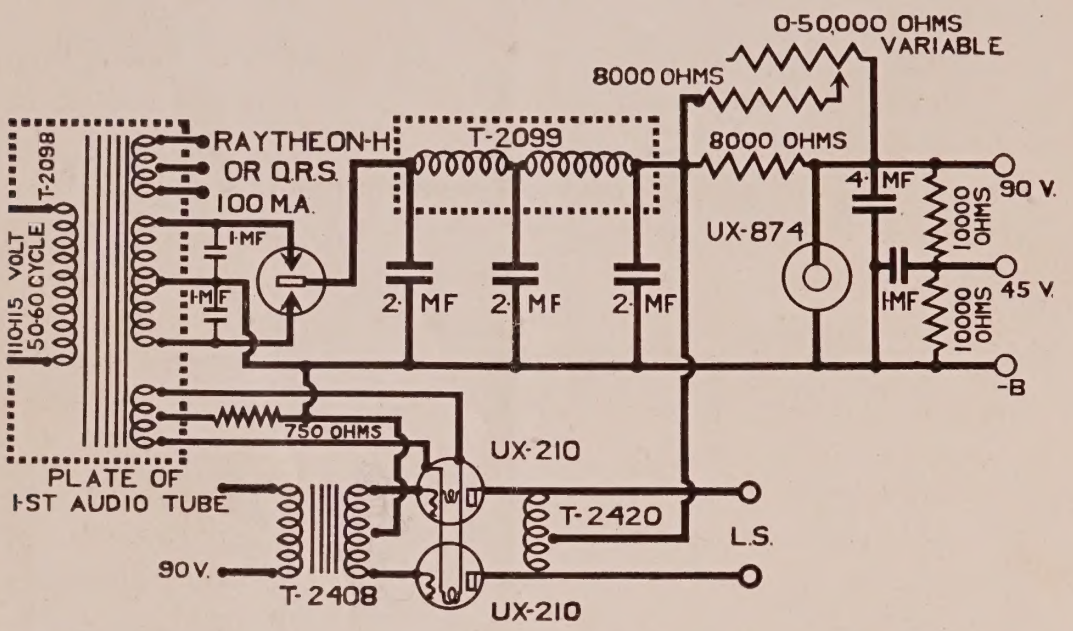
Schematic Diagram of Complete Power Amplifier and B-Supply Using Two UX-281 or UX-216-B Rectifiers

tubes, and is center tapped. This secondary is marked F-C-F. It will be noted that all of these secondaries are center tapped. The mid tap on Thordarson transformers is at the *exact* electrical center, and is obtained in a unique manner. Two perfectly balanced coils, representing the two halves of the secondary, are wound simultaneously, side by side, and are joined to form the mid tap, thus insuring a perfect balance. This is an important feature, for the perfect electrical center of the secondaries has much to do with the remarkable absence of hum in all Thordarson power amplifiers.

This transformer is designed primarily for use with the 281 type of rectifier. Two of these tubes are used to make full wave rectification. The voltage output of this rectifier is in inverse proportion to the current load. The total filtered output at a 100 milliampere load is approximately 470 volts, whereas at a 60 milliampere load the voltage is increased to approximately 565 volts. A substitution of the UX-216-B type rectifiers for the UX-281 type will result in a reduction of total output voltage of from 20 to 30 volts.

Certain types of gaseous, full wave rectifying tubes also may be used with this unit. A single Q.R.S. 100 milliampere, or a Raytheon type H rectifier may be substituted for the two

half-wave rectifiers. When a rectifier of this type is employed, it will be necessary to connect two 0.1 Mfd. condensers across each side of the high voltage winding. The schematic diagram below shows the circuit for this type of rectifier.



Schematic Diagram of Complete Power Amplifier and B-Supply Using a Raytheon Type H, or a Q.R.S. 100 Milliampere Rectifier

Because of the weight and bulk of the power supply transformer it was not practical to include the filter chokes in the same case as is done in both smaller types of Thordarson Power Compacts. The two 30 henry, 130 milliampere choke coils are therefore included in a separate compound-filled, steel encased unit, T-2099.

The balance of the filter circuit consists of three 2 Mfd. condensers in the condenser block. These condensers have a high D.C. working voltage to withstand the heavy voltage output of this amplifier. They are marked 2-2-2. The other side of these condensers terminate in the common lead marked C—. The condenser block also contains the necessary by-pass condensers, 4.0 Mfd., 1.0 Mfd., and 1.0 Mfd. The other side of the by-pass condensers terminate in the common lead marked B—. Unless grid bias for the tubes within the receiver is taken

from the power amplifier, the two common terminals B – and C – should be connected together. In the case of the Acme Parvolt condenser block, the negative side of both the filter and the by-pass condensers are brought out in one common lead marked O.

The B – supply feature of this power amplifier is designed so as to be universally adaptable to all receivers, regardless of their current drain. A unique method of controlling the B-supply is provided so that no more current is delivered to the 90 and 45 volt taps than is required by the receiver. An 8,000 ohm fixed resistor is placed between the high voltage and the 90 volt taps. Shunted around this resistor is another similar 8,000 ohm resistor and a Bradleyohm, R-5. By regulating the variable resistor, the total resistance between the high voltage and the 90 volt tap can be controlled from approximately 4,000 to 8,000 ohms. This provides a means of varying the current delivered to the 90 and 45 volt taps so as to cover the current consumption range of all existing receivers. This resistor should be adjusted to the point just above that at which the voltage regulator tube will glow. Current drain is thus reduced to the minimum, and maximum possible voltage is delivered to the plates of the power tubes.

An important feature of this assembly is the use of the voltage regulator tube, UX-874. This tube connected across the 90 volt B-supply, serves as a ballast to keep the lower B-voltages constant regardless of variations in load, within reasonable limits.

Only two B-voltages, 45 v. for one detector tube and 90 v. for the R.F. and A.F. stages are shown in the diagrams. These voltages will take care of the plate requirements of the average receiver. It is quite possible, however, to obtain any voltage within the maximum limits of the amplifier. To secure voltages between – B and 45 volts, substitute a Ward-Leonard Vitrohm Adjustat, 507-77 for the 10,000 ohm fixed resistance between the minus B and 45 volt taps. The variable mid-tap of this resistor will give you the intermediate voltage required. Simi-

larly, the same type of variable resistance substituted for the other 10,000 ohm fixed resistance will give an intermediate tap between the 45 v. and 90 v. taps. The Ward-Leonard 8,000 ohm fixed resistance (508-3) is tapped at 1,200 ohms. With the 1,200 ohm end of the resistor at the 90 volt side, the tap may be taken as a 135 volt supply. Any additional B voltage taps taken from this amplifier should be by-passed with a 1.0 Mfd. by-pass condenser.

The grid bias for the two UX-210 power tubes is secured through the voltage drop across the 750 ohm resistor which is placed between the mid-tap of the power tube filament supply and the mid-tap of the secondary of the push-pull input transformer. This grid bias is automatic and varies in proportion to changes in the power tube plate voltage.

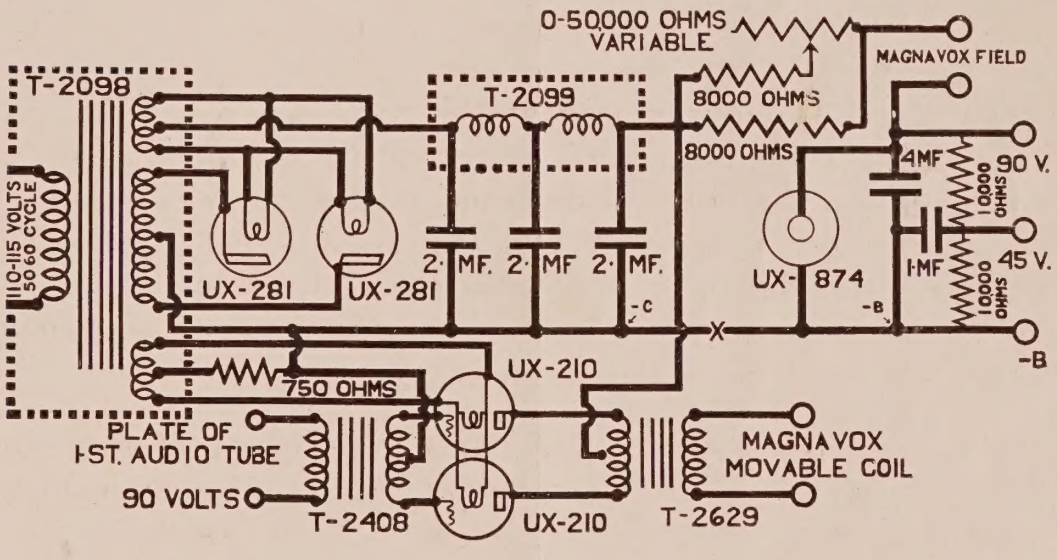
In certain cases it is possible also to obtain grid bias for the tubes in the receiver itself from the power amplifier, although this practice is not recommended in every instance. By separating the minus B lead at the point marked $-X-$ on the diagrams and inserting a small resistance you can obtain whatever bias you desire. In receivers where minus B is connected to minus A, use a 100 ohm resistor for each $4\frac{1}{2}$ volt drop desired. In receivers where minus B is connected to plus A, use a 225 ohm resistor for the first $4\frac{1}{2}$ volt bias, and 100 ohms for each $4\frac{1}{2}$ volt bias desired thereafter.

No power amplifier of itself can be the panacea of all radio ills. Unless the power stage is preceded by a first audio stage with a good tonal range and followed by a deserving loud speaker, some of the effectiveness of the amplifier will be lost. One of the most faithful reproducers to come to our attention is the Magnavox dynamic speaker, R-5. This speaker is of the free floating cone type which is actuated by magnetic reaction between a very strong, permanently excited field magnet and a light coil which is fastened to the apex of the cone and which carries the audio frequency currents.

The fact that the field coil of this speaker must be actuated by 100 volts, D.C., and requires a current of 40 milliamperes

flowing through this winding has been a serious handicap to those who would use this speaker. But very few power supply devices are capable of supplying the extra power required. The Thordarson heavy duty power amplifier, however, has sufficient reserve to take care of this additional load and bears the hearty endorsement of the Magnavox Company.

The coupling transformer included in the Magnavox R-5 is designed to couple the output of one UX-210 power tube to the speaker. When used in conjunction with a power amplifier using two UX-210 tubes in push-pull, it will be necessary to substitute the Thordarson transformer T-2629 for the coupling transformer in the Magnavox. The diagram below shows the changes in the amplifier construction to accommodate this speaker.



Schematic Diagram of Complete Power Amplifier and B-Supply for Use with Magnavox Dynamic Speaker R-5. Note that Transformer T-2629 is Substituted for Output Choke T-2420

As a final word of warning, remember that in this amplifier you are dealing with voltages approximately five times that of the house lighting current. Do not touch the amplifier or attempt any changes without first disconnecting the amplifier from the light circuit.

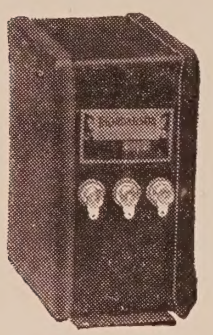
Unless a power relay is used to control the power input to the amplifier, always turn off the amplifier before turning off the receiver, and always turn on the receiver before turning on the amplifier. This is recommended to protect the condenser block against the possibility of high voltage surges.

THORDARSON PARTS
For 210 Push-Pull Power Amplifier

Heavy Duty Power Supply Transformer T-2098

A conservatively rated, full wave rectifier supply of 130 milliamperes. Designed for use with two UX-281 or two UX-216-B rectifier tubes. Also contains filament supply for two UX-210 power tubes.
Specifications:
Primary: 110-115 volts, 50-60 cycles. **Secondary No. 1:** 550 volts each side of center tap, 130 M.A. **Secondary No. 2:** 7.5 volts, center tapped, 20 V.A. **Secondary No. 3:** 7.5 volts center tapped, 20 V.A.
Dimensions: 4½″x5¼″x5¾″ high.

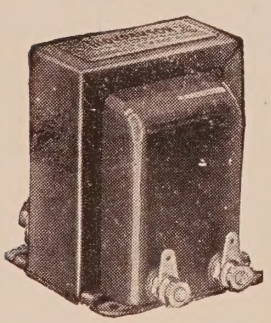
T-2098 ..... $20.00



Double Choke Unit, T-2099

Consists of two individual chokes of 30 henries, 130 M.A. each, in one compound filled case. Designed for filter circuit of rectifier above.
Dimensions: 3¼″x4⅞″x5⅝″ high.

T-2099 ..... $14.00



Power Push-Pull Transformers

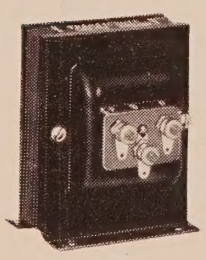
Quality reproduction that cannot be obtained with straight audio amplification is made possible with the Thordarson Power Push-Pull system. Designed for use with all existing power tubes including the UX-210 type.
Dimensions: 2½″x2½″x3″ high.

Input Transformer

T-2408 ..... $8.00

Output Choke

T-2420 ..... $8.00



Coupling Transformer for R-5 Magnavox Speaker, T-2629

A special push-pull output transformer designed to couple a stage of UX-210 push-pull amplification with the Magnavox speaker, R-5. This transformer replaces the coupling transformer in the speaker, which is intended for use with only one power tube.
Dimensions: 3″x3¾″x3⅝″ high.

T-2629 ..... $10.00

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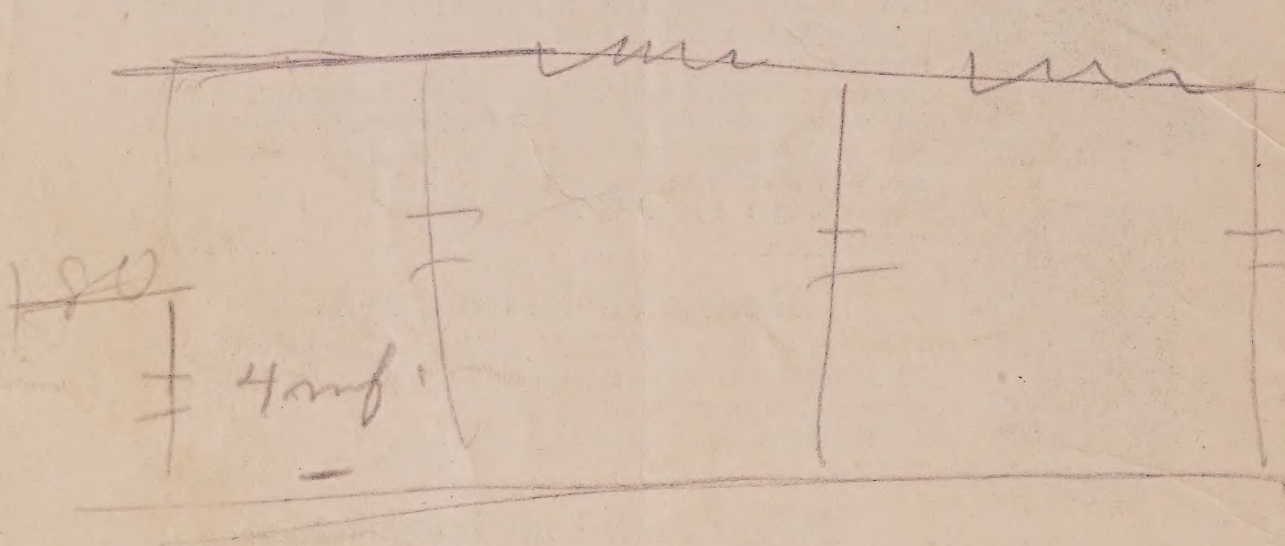

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